

HOW DOES BILATERAL TRADING DIFFER FROM ELECTRICITY POOLING?

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ABSTRACT: *Bilateral trading and electricity pooling represent two different models for generators and buyer to trade in electricity. This paper explores how both models operate and what characteristics distinguish them from each other. The paper seeks to show how each market model determine prices and deals with imbalances, and constraints on the electricity transmission system. The paper also shows that while each model has its own advantages and disadvantages, none is superior to the other.*

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List of Abbreviations

Abbreviation	Meaning
CEPMLP	Centre for Energy, Petroleum, Mineral Law and Policy
CfD	Contract for Differences
CP	Capacity Payment
LOLP	Loss of Load Probability
NETA	New Electricity Trading Arrangements
PPP	Pool Purchase Price
PSP	Pool Selling Price
SBP	System Buy Price
SMP	System Marginal Price
SSP	System Sell Price
UK	United Kingdom
US	United States
VOLL	Value of Lost Load

1 Introduction

The electricity industry can be viewed as a combination of several activities comprising generation, transmission, distribution, supply, and metering¹. The industry was traditionally composed of vertically integrated companies.²

Since the introduction of electricity industry liberalisation in the 1980s, more countries around the world have replaced vertical integration and reorganised the production of electricity around markets³. Conceptually, competition can be established at several levels in an electricity industry as liberalisation programmes consider each industry activity separately⁴. One of the most pertinent questions for liberalisation programmes, in the light of key objectives such as reducing electricity prices while keeping the lights on, is how to arrange electricity trading between generators and buyers in the wholesale market.

There is no ready-made answer to this question as different electricity market structures and regulatory policies exist in different countries. It is possible, however, to identify two main market arrangements from the several models implemented around the world - electricity pools and bilateral contracts model⁵.

At the most basic level, electricity pooling is a centralised form of trading electricity with competition focused solely on generators with minimal input from buyers. The bilateral model is a more market-oriented design that encourages more interaction between generators and buyers. There are key differences in the manner in which both models deal with key market issues such as determination of the electricity wholesale price, determining when generators increase or decrease plant output or stop generating (scheduling and dispatch), the incidence of generation/ demand shortfalls or excess (imbalances), and the constraints on transmission capacity that may affect system stability. Another key difference is the role of the system operator in each model⁶. This paper seeks to highlight and analyse these differences.

This paper is organised as follows: Section 2 presents a descriptive analysis of how electricity pooling and bilateral trading operate; Section 3 analyses how both models differ in market

¹ Dow, S., *Electricity Privatisation, Liberalisation and Contracting*, (Lecture Notes on Downstream Energy Law and Policy, CEPMLP, University of Dundee, 2008)

² Hunt, S., *Making Competition Work in Electricity*, New York (US), John Wiley & Sons, Inc., 2002

³ Green, R., *Electricity and Markets*, Vol. 21 No. 1, OREP, pp. 67-87 (2005)

⁴ *Supra*, note 1

⁵ Barroso, L.A. et al, *Classification of Electricity Market Models Worldwide*, at <http://www.cigre-c5.org/Site/Publications/download/2005%20San%20Antonio%20-%20TF%20C5-2%2011D45VER59.pdf>, (last visited on 15 January 2009)

⁶ System operations is the function that ensures that the amount of electricity generated is enough to meet the total amount used by consumers at any point in time (the load). The system operator is responsible for keeping the electricity system in balance – *Supra*, note 2 at 20-21

structure and market rules/ procedures; Section 4 presents the transition from an electricity pool to a bilateral model by examining the England and Wales electricity industry experience; Section 5 provides the conclusions of the research.

2 How do Bilateral Trading and Electricity Pooling Work?

2.1 What is an Electricity Pool?

An electricity pool facilitates competition between generators and the calculation of the price paid for electricity by buyers. All the market participants– generators, system operator, market operator, suppliers, etc., are signatories to a pooling agreement that guide the operations of the pool⁷.

A pool can be a compulsory pool or a voluntary pool. A compulsory or gross pool requires all generators, except the smallest ones, to sell their output to the pool at the pool's price. In a voluntary or net pool, generators can agree bilateral trades with buyers for the delivery of electricity, but must inform the system operator who takes it into account when scheduling⁸.

Electricity pools require generators to submit bids indicating how much electricity they can generate at a given price. The generators can bid at any price they like (price-based pools) or the bid price could be based on predetermined variable costs (cost-based pools)⁹.

A pool can also be referred to as one-side or two-sided. In a one-sided pool, the market operator predicts demand and dispatches generators against this demand assumption with no input from buyers. In a two-sided pool, the market operator dispatches based on the quantity demanded by the buyers and the demand curve of the buyers¹⁰.

2.2.1 How does a Pool Operate?

Electricity pools operate on similar basic principles¹¹. The UK model (the England and Wales Power Pool, 1990-2001) is the most famous example and has deeply influenced reform processes in several countries in Europe, Latin America and Asia¹².

Pools usually operate on an hourly basis with generators competing to meet demand each hour. This means there will be 24 different pool markets in a day. The decision on the number of

⁷ What is the Electricity Pool?, http://www.elecpool.com/about/about_f.html, (Last visited on 16 January 2009)

⁸ *Supra*, note 3

⁹ *Supra*, note 5

¹⁰ *ibid*

¹¹ *Supra*, note 1

¹² MacKerron, G., *Electricity in England and Wales: Efficiency and Equity*, in Competition in European Electricity Markets: A Cross Country Comparison, 41 (Glachant, J. and Finon, M., eds., Cheltenham, UK: Edward Elgar Publishing, Inc., 2003)

separate markets a pool should have is a policy decision based on the demand curve and the system's ability to cope with the administrative burden¹³.

A pool can run several combinations of day-ahead, intra day or close to real time spot markets¹⁴. In a gross pool, generators submit bids for supplying a given volume of power at a specific price, usually a day ahead. The market operator accepts bids from generators, starting with the cheapest, until the demand forecasts are met. Generators are 'in merit' when their bids are successful and 'out of merit' when unsuccessful¹⁵.

The system operator then uses a computer programme to generate a schedule of the least cost generation for the trading day. This is called the unconstrained schedule, as it assumes that there will be no constraints in the transmission of electricity¹⁶.

On the day of trading, several issues will arise such as errors in the demand forecasts, the unavailability of 'in-merit' generators, etc. The system operator factors these changes into the unconstrained schedule to develop the constrained schedule¹⁷. The system operator usually adjusts "these schedules to deal with imbalances, congestion, and ancillary services"¹⁸.

The final price paid to the generators is a combination of several elements described as follows¹⁹:

- i. System Marginal Price (SMP): this is the bid price of the marginal unit (the most expensive generator) required to meet forecast demand in a market period²⁰;
- ii. Loss of Load Probability (LOLP): this is the probability that electricity generated will not meet demand²¹. LOLP is likely to be small in capacity excess systems/ periods²²;
- iii. Value of Lost Load (VOLL): this is "an estimate of the value to consumers"²³, the maximum price attributed to the supply of electricity demand²⁴;

¹³ *Supra*, note 1

¹⁴ *Supra*, note 5

¹⁵ *Supra*, note 1

¹⁶ *How Prices are Calculated*, at http://www.elecpool.com/prices/prices_calculated.html, (Last visited on 16 January 2009)

¹⁷ *ibid*

¹⁸ Ancillary services include services such as frequency response, voltage stability and operating reserves, the production of which is necessary to make the transmission system work. The plants that would produce these services are also required to produce energy - *Supra*, note 2 at 130

¹⁹ *Supra*, note 1

²⁰ Staropoli, C., *Reforming the Reform in the Electricity Industry*, in Competition in European Electricity Markets: A Cross Country Comparison, 61-63 (Glachant, J. and Finon, M., eds., Cheltenham, UK: Edward Elgar Publishing, Inc., 2003)

²¹ *ibid*

²² *Supra*, note 1

²³ *Supra*, note 2 at 166

²⁴ *Supra*, note 16

- iv. Capacity Payment (CP): this is the payment for any available capacity, irrespective of whether the generators produced or not. It may rise during periods of shortages but falls when system capacity exceeds demand²⁵.

In the UK model, the sum of the SMP and CP (calculated as LOLP x (VOLL-SMP)) results in the Pool Purchase Price (PPP), which is calculated before the day of trading. The addition of the uplift payment to the PPP produces the Pool Selling Price (PSP). The PSP is the price paid by buyers and paid to generators. The uplift payment covers the costs of transmission (including transmission system losses) and is the difference between the unconstrained schedule and the cost on the trading day^{26, 27}.

2.2.2 Contracts for Differences

The price of electricity within a pool varies from one market period to the next during a single day as demand fluctuates²⁸. Buyers and sellers seek to hedge against this price volatility by entering into bilateral contracts called Contract for Differences (CfD). The buyer and seller agree a specific volume and price ('strike price') in the CfD. If the pool price is higher than the strike price, the seller pays the buyer the difference and if it is lower, the buyer pays the seller the difference²⁹.

Bilateral contracts can be traded in a forward market that usually exists side by side with the pool. The standardised contracts traded are purely financial in nature as no physical delivery of electricity occurs. The contracts can be traded from six month up to fifteen years ahead^{30, 31}.

2.2 What is Bilateral Trading?

The bilateral trading model involves generators and buyers (suppliers or large customers) entering into bilateral contracts for the sale of electricity. Generators can also be buyers, for example when they do not generate enough power on their own. Though not strictly necessary, intermediaries (brokers) can sometimes facilitate the trade between buyers and sellers³².

²⁵ *How Prices are Calculated*, at http://www.elecpool.com/prices/three_basic_prices.html, Last visited on 16 January 2009)

²⁶ *ibid*

²⁷ *Supra*, note 16

²⁸ *Supra*, note 2 at 168

²⁹ *Supra*, note 1

³⁰ Amundsen, E.S. and Bergman, L., *The Deregulated Electricity Markets in Norway and Sweden: A Tentative Assessment*, in *Competition in European Electricity Markets: A Cross Country Comparison*, 61-63 (Glachant, J. and Finon, M., eds., Cheltenham, UK: Edward Elgar Publishing, Inc., 2003)

³¹ Bower, J. and Bunn, D. W., *Model-Based Comparisons of Pool and Bilateral Markets for Electricity*, Volume 21 Issue 3, TEJ (2000)

³² *Supra*, note 5

The England and Wales electricity market, since 2001 under the New Electricity Trading Arrangements (NETA), is an example of a bilateral trading market.

2.3.1 How does Bilateral Trading Operate?

The trading parties (a buyer and a seller) typically negotiate a set of master terms and conditions that form the basis of trade between them. Once the master agreement has been finalised, electricity trading can then commence on contracts of any length³³.

The contracts specify the amount and price of electricity to be traded and when the trade will take place. At a set time before delivery (gate closure), “participants disclose their net contract sales and purchases to the system operator”³⁴. Each generator decides on when to dispatch and the system operator is required to manage the imbalances that occur. Since the system operator does not own any generating capabilities to balance the system, a way must be devised to pay for the imbalances³⁵.

There are two options available – a market price or a punitive price. A number of factors affect the option the market adopts including the cost of maintaining system security. In Norway, where electricity is generated via relatively inexpensive hydro plant and a large volume of the power is sold via contracts with some sold in the spot market, the price from the spot market is used to settle imbalances. This is in contrast to the practise in England and Wales (under NETA) that penalises shortfall imbalances and reward surpluses via a dual pricing system³⁶.

The system operator auctions tradable transmission rights to manage congestion³⁷. The auction resolves who the users of the transmission system will be and the price they will pay³⁸.

3 How does Bilateral Trading Differ from Electricity Pooling?

The characteristics of both market designs highlight several advantages and disadvantages. It is clear the basic functions of the pool will always be required in one form or the other. One of its major benefits is that it provides a market for generators unable to sell their output via contract to a specific customer or who are looking for market for excess production³⁹. On the other hand, bilateral trading provides a more opportunities for buyers and sellers to trade electricity by not restricting them to one particular method.

³³ *Supra*, note 1

³⁴ Shuttleworth, G., *Hot Topics in European Electricity: What Is Relevant and What Isn't?*, Volume 15 Issue 8, TEJ, Pages 25-39 (2002)

³⁵ *Supra*, note 2 at 149

³⁶ *Supra*, note 34

³⁷ *Supra*, note 20

³⁸ *Supra*, note 2 at 153

³⁹ Hogan, W.W., Reshaping the Electricity Industry, at <http://ksghome.harvard.edu/~whogan/hiid797a.pdf> (Last visited on 20 December 2008)

This section attempts to examine the conceptual differences between bilateral trading and pooling from two perspectives – market structure and market rules/ procedures⁴⁰.

3.1 Differences in Market Structure

3.1.1 The Role of the System Operator

The structure of both models differs conceptually. While an electricity pool is a highly centralised market with the central scheduling and dispatch of generators, the bilateral model is a decentralised one that relies on self dispatch. The system operator within the pool utilises a merit order to dispatch generators in a least cost manner. Under the bilateral model the system operator is constrained in scheduling by the negotiated contract price and volumes between the generators and suppliers^{41, 42}.

What is quite clear is that the role of the system operator is important under both design models. In addition the system operator must have the necessary information and infrastructure to ensure the system stability is maintained.

3.1.2 The Role of Contracts

The role of contracts in scheduling and dispatch within both models also differ. Under pools, the contracts between market participants are purely financial with market participants using them to manage their financial risk. The system operator does not take them into consideration when scheduling and dispatching generators. However, in bilateral trading, contracts are the main instruments by which electricity is traded. The system operator must use the contracts in the scheduling and dispatch process⁴³.

3.2 Differences in Market Rules and Procedures

3.2.1 Determination of the Wholesale Price of Electricity

Markets are said to be arrangements that enable supply to match demand at an equilibrium price. In this context, an electricity pool cannot be considered to be a market as buyers are not involved in the price determination process and prices set within the pool do not significantly affect electricity demand⁴⁴. The bilateral model provides a better approximation of a market as buyers and sellers are involved in the trading process.

⁴⁰ Staropoli, at *supra note 20*, utilises this approach in her examination of the transition of the England and Wales Electricity Pool to NETA. This paper has leveraged on the basic idea of that approach.

⁴¹ *Supra*, note 5

⁴² *Supra*, note 2 at 148

⁴³ *ibid*

⁴⁴ Neushloss, J. and Woolf, F., *Review of the England and Wales Trading Arrangements: The Proposal to Cure the Ills by Euthanasia of the Pool*, Volume 12 Issue 10, TEJ, pp 27-36 (1999)

In a pooling model, the price buyers pay and successful bidders are paid is a single price which is determined in the pool. This price, however, varies significantly throughout the day as demand fluctuates. Hence, market participants use hedging instruments, such as CfDs, to manage this price volatility. Prices in the bilateral model are negotiated between a buyer and seller and are thus less volatile than in a pool⁴⁵.

There is also high likelihood of the imposition of price caps within a pool especially in capacity short situations or where “demand response is limited or absent”⁴⁶. The probability of this happening in bilateral trades is significantly very less.

3.2.2 Dealing with Imbalances

All electricity systems must balance at any moment in time to ensure stability. In a gross pool all power generated and consumed is treated as an imbalance and settled at the final pool price⁴⁷. The spot market also serves as the imbalance market. In bilateral trading, the system operator has to buy and sell in a separate balancing market to ensure system stability^{48, 49}.

Similarly, congestion management under pooling can be administered more economically than under bilateral trading where it is more complex⁵⁰.

Thus, the pool integrates the pricing of imbalances, congestion management and ancillary services with the spot market. The bilateral trading model usually requires the separate operations of markets for these services⁵¹.

4 Transiting from Pooling to Bilateral Trading: The England & Wales Experience

A majority of electricity markets have implemented pooling or the centralised model, in one form or the other, in their liberalisation programmes⁵². The advantages of tight coordination through centralisation, as obtained under the traditional organisation of the electricity industry, made it an easy option for early electricity markets to adopt. This addressed concerns about security of supply in the liberalised industry⁵³.

⁴⁵ *Supra*, note 5

⁴⁶ *Supra*, note 2 at 132

⁴⁷ *Supra*, note 31

⁴⁸ *Supra*, note 2

⁴⁹ *Supra*, note 31

⁵⁰ *Analysis of Liberalization Models for Electricity Markets*, at http://criepi.denken.or.jp/en/e_publication/a2003/03seika1.pdf, (Last visited on 18 January 2009)

⁵¹ *Supra*, note 2

⁵² *Supra*, note 2 at 132

⁵³ Green, R., *Failing Electricity Markets: Should We Shoot the Pools?*, Volume 11 Issue 3, UP Pages 155-167 (2003)

The success of electricity markets designed around the pooling model reduced concerns about security of supply and enabled policy makers to begin to think about the demand-side. Electricity market designs now adopted a bilateral model and gave generators and suppliers the freedom to trade via contracts⁵⁴.

The England and Wales Power Pool (the Pool) was established in 1990 and represented the first important attempt to introduce a market for the electricity generation. It has attracted a lot of attention and been influential in shaping the electricity liberalisation process of several countries around the world.⁵⁵

The challenges encountered in the Pool prompted a regulatory review of the market that led to the implementation of a model of bilateral contracts under the new electricity trading arrangements (NETA) in 2001⁵⁶.

The England and Wales experience represented the first reform of an existing market⁵⁷ and provides a very good example to examine the switch from a pooling model to a bilateral trading.

4.1 Moving Away from the Pool

4.1.1 The Challenges Faced by the Pool

The main criticism of the Pool was the level of market power exercised by generators⁵⁸. It was argued that the establishment of the Pool created a duopoly in which the two major generators determined the price of electricity 90 per cent of the time⁵⁹. They were discovered to have used their market power to increase the pool prices during certain period when conditions indicated prices should be moving downward⁶⁰.

The Pool was a one-sided pool with a focus on the supply-side. This meant that there was no input from the demand-side in price setting. Electricity purchasers complained of the one-sided nature of the Pool and its unresponsiveness to their concerns. They also complained that prices were too high and volatile⁶¹.

⁵⁴ *ibid*

⁵⁵ *Supra*, note 44

⁵⁶ *ibid*

⁵⁷ *Supra*, note 20 at 58

⁵⁸ *Supra*, note 20 at 57

⁵⁹ Newberry, D.M., *The Regulator's Review of the English Electricity Pool*, at <http://www.econ.cam.ac.uk/faculty/newbery/files/UTILWEEK.PDF> (Last visited on 16 December 2008)

⁶⁰ *Supra*, note 20 at 57

⁶¹ Offer, *Review of Electricity Trading Arrangements: Working Paper on Trading Inside and Outside the Pool*, at <http://www.ofgem.gov.uk/Markets/Archive/Review%20of%20electricity%20Trading%20Arrangements%20working%20paper%2029%2003.pdf>, (Last visited on 18 January 2009)

The Pool rules provided the framework for trading (via an auction) and for determining the spot price of electricity⁶². Generators sent in various bids to supply electricity in the pool markets the next day and the price of electricity in each pool market was calculated based on the bids determined to be in merit. While conceptually simple, in practice the bidding and price calculation rules were very complex and lacked transparency. This situation, coupled with the non-firm nature of bids, resulted in incidences of rule manipulation or ‘gaming’^{63, 64}.

Another criticism of the Pool was the administration of a capacity payment based on estimates of LOLP and VOLL which opponents of the pool felt should not be part of a competitive market. It was argued that capacity payments rewarded shortages by providing an incentive for generators to withdraw plants from the market shortage rather than encouraging new generation as it was meant to do^{65, 66}.

Moving away from the pool required changes in the way the market was organised as well as the rules guiding the operations of the market and the action of market participants.

4.1.2 Transiting to NETA

Under NETA, the organisation of the electricity market moved from centralisation towards more dependence on markets. No central market exists until just prior to real-time. The market allows generators and buyers to directly trade electricity without the involvement of the system operator. This interaction has enabled buyers and sellers to schedule on the network and also allowing the generators to determine when to produce electricity (self-dispatch)^{67, 68}.

NETA also ensured a move away from the auction rules that determined the uniform price of electricity under the Pool. While there are various auction rules under NETA, auctions under the Balancing Mechanism has received the most attention. The Balancing Mechanism, which is run by the system operator, was established to maintain system stability by ensuring markets participants pay for shortfalls or are paid for excesses⁶⁹.

The Balancing Mechanism utilises a dual pricing system to pay for imbalances. Market participants (including generators, suppliers, traders and some large consumers) pay for (or are paid for) imbalances. Participants who run a deficit i.e. generators who supply less than and

⁶² *Supra*, note 2 at 359

⁶³ Green, R., *Draining the Pool: The Reform of Electricity Trading in England and Wales*, Volume 27, EP pp 515-525 (1999)

⁶⁴ *Supra*, note 20 at 62

⁶⁵ *Supra*, note 63

⁶⁶ Thomas, S., *The Wholesale Electricity Market in Britain – 1990-2001*, at <http://www.psim.org/reports/2001-09-E-Uk-market.doc>, (Last visited on 4 January 2009)

⁶⁷ *Supra*, note 2 at 367

⁶⁸ *Supra*, note 20 at 62

⁶⁹ *Supra*, note 20 at 63

buyers who consume more than the stipulated contract volumes, pay the system buy price (SBP). On the other hand, participants who run a surplus i.e. generators who generate more than and buyers who consume less than the stipulated contract volumes are paid the system sell price (SSP). The SSP is usually rather lower than the SBP to ensure market participants do not rely on the system operator to balance^{70, 71}.

4.2 How Effective has the Transition Been?

The success of the transition from the Pool to NETA may be evaluated on how well it has performed in advancing competition and reducing price.

When NETA came into effect in 2001, the number of generators had increased to 35 compared to 6 when the Pool was established. This led to considerable reduction in market concentration⁷². In addition, 8 suppliers had replaced the 14 regional electricity supply monopolies. The liberalisation of the retail market in 1998 enabled these suppliers to compete across the whole spectrum of the market⁷³.

Prior to the implementation of NETA, most generators had migrated from expensive coal-fired plants to more economic combined cycle gas turbines. This had a direct effect on electricity prices. Wholesale electricity prices had reduced by about 20% from their 1998 levels (when expensive coal contracts expired) and had reduced by a further 25% in the first year of NETA. Since then, however, the wholesale electricity prices have tended to rise overall as a result of increases in the wholesale price of gas^{74, 75, 76}.

The greater reliance of markets has also had security of supply implications. From the period of a few years before NETA until about 2002, it was estimated that there was on average at least 20% generating capacity over expected demand. Lower wholesale prices however caused generators to withdraw capacity. This led to the market operator warning of the likelihood of significant shortages and encouraging generators to restore capacity. Generators responded thus averting potential problems⁷⁷. However, this presents a risk to the industry that was minimised under the pools.

⁷⁰ *Supra*, note 34

⁷¹ *Supra*, note 2 at 149

⁷² Neil Bryson, N., *Why NETA May Prove an Expensive Flop*, at <http://www.independent.co.uk/news/business/comment/neil-bryson-why-neta-may-prove-an-expensive-flop-689176.html>, (Last visited 20 January 2009)

⁷³ *ibid*

⁷⁴ *Supra*, note 34

⁷⁵ Tovey, N.K., *Developments in the Electricity Markets in the UK: The Move Towards BETTA*, at http://www2.env.uea.ac.uk/gmmc/neta/EBPOC_HER_O_2005_Tovey.pdf, (Last visited on 26 December 2008)

⁷⁶ Thomas, S., *The British Model in Britain: Failing Slowly*, Volume 34 Issue 5, EP, pp 583-600 (2006)

⁷⁷ *ibid*

5 Conclusion

The electricity pool and bilateral trading models represent two conceptually different electricity market designs. One is completely centralised focused on increasing competition between generators while the other is a decentralised model focused on encouraging greater interplay between the demand and supply sides.

Are electricity pools superior to bilateral trades, or vice versa? No clear answer emerges as each has its own strengths and weaknesses. Different countries have adopted variations of both market models to meet specific objectives that were identified for their particular markets.

However does it matter which model is adopted in an electricity industry if the lights stay on? The question may be viewed as rhetorical in which a simple answer would suffice. On the other hand, it could provide the catalyst for further in-depth investigation.

This study has its limitations. It was unable to examine situations where electricity pools and bilateral trading exist side-by-side, as in the case of the NordPool. It was also unable to examine a situation in which transition from bilateral trading to a pooling model takes place. These limitations could provide the springboard for further research.

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